Nerve Expert: A Frame-Based Educational System For Peripheral Neurology

Chiang S. Jao, Ph.D., Steven U. Brint, M.D., and Daniel B. Hier, M.D.
Department of Neurology, College of Medicine, University of Illinois at Chicago
Chicago, IL 60612

ABSTRACT

Computer-based educational programs offer students the opportunity for active, self-paced, independent learning, giving teaching faculty more flexibility. Learning about the peripheral nervous system is an arduous and time-consuming process for students and house staff. The peripheral nervous system is complex with many nerves, muscles, and muscle actions to memorize. The complexity of the peripheral nervous system does not lend itself well to passive learning by either lecture or reading. We have designed a computer-based teaching unit to teach the basic knowledge of the peripheral nervous system required for Neurology. This teaching unit is aimed at both medical students and house staff. Our teaching unit is designed with five basic components: Pre-Test, Post-Test, Tutorial, Knowledge-Base, and User-Database. In designing the teaching unit, we established the following criteria: the unit should engage the user interactively, it should make heavy use of both text and graphics, it should provide immediate feedback, it should be flexible in use so that the user learns selectively, and it should provide a permanent record of user performance.

The Nerve Expert Pre-Test is a set of multiple choice questions designed to assess the user's baseline knowledge. The Pre-Test is repeated as a Nerve Expert Post-Test to assess learning related to completion of the teaching unit. The Nerve Expert Tutorial consists of over 150 distinct teaching frames to be traversed in linear order to provide a complete tutorial. The tutorial frames are a combination of text and images that provide the user with core information about nerve/muscle structure and pathophysiology. This core information is reinforced by quizzes and case studies. Teaching frames are a variety of reusable frame types: text only, text with hypertext, text with image, true-false questions, multiple choice questions, or matching questions. The Nerve Expert Knowledge-Base is a collection of data relevant to peripheral nerves and muscles to be queried by the user through a button bar at the base of all Nerve Expert screens. The User-Database stores information about users of the systems and their performance on the system.

Our teaching unit is implemented in KnowledgePro® for Windows (KPWIN®), an expert system shell with hypermedia capabilities. The backward-chaining feature in the KPWIN® was used to implement a rule-based expert system with IF-THEN statements. The hypermedia capability of the KPWIN® supports the use of text, graphics, hypertext, and hypergraphics. KPWIN® allows the development of a clear and simple user interface based on hypertext and hypergraphics objects. The object-oriented programming (OOP) features of KPWIN® allow message sending and class inheritance among different objects. This reduces program size and complexity.

In our teaching unit, we designed multiple frame types to display text and images in different layouts. The displayed screens are either fact-based (supplying the user with a fact) or problem-oriented (providing the user with a question to answer or a case to solve). Hypermedia objects are highlighted in underlined format and green-colored to provide various program control: including supply answer, view images, or search knowledge base. The anatomical images used in our system consisted of commercially available clipart or captured images (from scanner or digitized photograph). We designed a database entry tool to enter the nerves, muscles, and actions into the knowledge base to accommodate one-to-one, one-to-many, or many-to-one relationships among data items. We used a contextual data-indexing method supported by KPWIN® to speed up data retrieval from the knowledge base. The accumulated test scores and quiz status of each user are collected in a database file for statistical and review purposes.

Our goal has been to develop an interactive teaching unit for medical students and house staff that teaches the fundamentals of peripheral neurology. The Nerve Expert is a comprehensive teaching tool that provides users with an interactive introduction to peripheral neurology that maximizes feedback to the user and minimizes the need for neurology faculty to repeat introductory lectures to medical students and house staff.

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